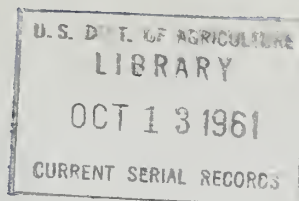


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ATTITUDINAL RESEARCH RELATING TO FARMERS' USE OF SHORT-TERM CREDIT

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Farm Economics Division

Economic Research Service

UNITED STATES DEPARTMENT OF AGRICULTURE



Growth Through Agricultural Progress

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ATTITUDINAL RESEARCH RELATING TO FARMERS' USE OF SHORT-TERM CREDIT

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SUMMARY

Guttman scale analysis is a useful and not too difficult way of arranging the attitudes of a group of respondents on a continuum of favorableness-unfavorableness. It is a way of recording and analyzing subjective attitudes of people, and of quantifying them as the usual economic factors are quantified. It requires a certain familiarity on the part of the researcher with the attitudes under study, and a little patience in working out a set of statements that fall on a single continuum. Guttman scale analysis was found to be a useful addition to other methods in studying reasons for the use and nonuse of credit and insurance by dryland farmers.

Both rank correlation and paired comparisons are available to the researcher who wants a simple, ordinal, preference ordering of items. These items may be attitudes, policies, preferred actions, or anything else that is meaningful to the respondent. We prefer paired comparisons to the rank correlation because this method gives scale separation between items, as well as the rank order. Both methods are limited to a relatively short list of items, unless the respondents are a selected group with a great deal of patience.

These three techniques can be tested for statistical validity and otherwise manipulated to reveal the presence or absence of concomitant influences, upon which hypotheses are founded or upon which they founder. Fellow researchers who deal with socio-economic activities, such as farm management, may find these techniques useful.

INTRODUCTION

At some time, most economists may wonder why farmers, who take pride in being practical, often are impractical in economic matters. Why, for example, doesn't a farmer use bank credit to expand his business when economic analyses show that it would pay? Other analyses may indicate other seemingly profitable courses of action, but the farmer may not take advantage of his opportunities. Why is this so? Is it because some farmers hold attitudes and beliefs against doing certain things like using credit? And do these attitudes and beliefs blind farmers to the economic opportunity in question?

In the study reported, some of the tools used by social psychologists in attitudinal research were applied with some degree of success. These tools are not unknown to research economists, but they are little known to, or used by, most of us. The three methods of identifying and measuring the strength of attitudes that were found may be useful to other economists. Data gathered for the purpose are used to explain each method.

The study was concerned with things that affect the availability of short-term credit to dryland farmers in Montana. The money supply of lenders and the security offered by borrowers caused no problem. These data could be handled in a straightforward economic analysis. But under the usual assumptions of static analysis, there is no place for the farmer who does not use credit simply because he doesn't want to or because he doesn't know it is available to him. Nor is there a place for the lender who turns down an application because he is negatively impressed by the applicant's character, manner of speech, dress, and so on. Usually these things are considered to be nonrational behavior and are assumed away.

If such things as those mentioned are to be included within a rational model, subjective intrapersonal attitudes must be recorded and analyzed. A personal attitude must be treated as an objective datum - a predictable phenomenon. Unfortunately, standard economic methodologies do not permit such a procedure.

One segment of commercial activity is called Motivation research. Ordinarily, its practitioners are not concerned with theoretical constructs, but rather with assessing the market for various consumer goods. These are the opinion pollsters and the research adjuncts of the advertising business. In the more academic circles of social psychology and allied disciplines, some interest is evident in building theories and methodologies to explain and duplicate under controlled conditions the things the practitioners are doing.

The methodologies and models of academicians and some of the results of researchers in the field of motivation can be useful in any attack on such economic problems as the use and availability of credit. This statement is supported in the paragraphs that follow.

In this study of credit use and availability, 96 case studies of short-term agricultural loans were collected from a sample of principal lenders in the dryland cropping areas of Montana. 1/ As much information as possible was obtained for each loan. Each lender was asked what things he considered in his decision to make or deny short-term loans to dryland farmers. He was asked also whether he considered each sample case a good risk or a poor one, and why.

From the results of this inquiry, a questionnaire was drawn up and used in interviewing a number of lenders representing the three types of lending agencies whose trade area includes the dryland farming areas in Montana. 2/ These interviews furnished data on lending practices and on the attitudes of lenders that affect these practices. Finally, a sample of dryland farmers in the same geographic areas were

1/ Six cases were included from each of 6 banks and production credit associations and 4 cases from each of 6 Farmers Home Administration Offices.

2/ The 71 lenders cooperating in the study included 45 from commercial banks, 16 from production credit associations, and 10 from the Farmers Home Administration.

asked about their borrowing practices.^{3/} They were also asked questions that revealed their attitudes toward using short-term credit and their notions of lenders' attitudes toward borrowers' attributes.

The methodologies borrowed from social psychology for testing attitudes were Guttman-scale analysis, rank correlations, and paired comparisons. Experience with each technique is reported in a separate section.

THE GUTTMAN SCALE

Attitude scales are useful in making comparative assertions of degree between subjective attitudes. The researcher may want to say, for example, that farmer A has a more positive attitude toward credit than farmer B, rather than saying only that their attitudes differ. A farmer's attitude toward credit (or toward any subject) can be determined from his responses to a set of appropriate statements. If the set is to be effective, the statements should meet the following requirements:

- (1) They should refer to the present rather than the past;
- (2) They should not be statements of fact;
- (3) They should refer to the attitude to be scaled;
- (4) They should cover the entire range of the effective scale of interest;
- (5) They should not be the kind likely to be agreed with or disagreed with by almost everyone; and
- (6) Their language should be kept simple, clear, and direct.

If these criteria are met, the statements will have the same meaning for all respondents; they will provide a common frame of reference for the attitude under study.

We asked 210 dryland wheat farmers to answer 10 questions about the use of short-term credit. (See appendix, page 21.) Answers to seven of the questions were used in the analysis.

Of the several techniques of measuring the attitude of respondents, the Scalogram method was chosen. This method is commonly called the Guttman scale after L. A. Guttman, who developed it in the late forties. The objective is to assign individuals to a serial position along a unidimensional continuum. This means that the respondent with the highest scale score ranks as high as or higher than any other respondent on each statement in the set. This establishes a continuum ranging from least to most favorable with respect to the object - attitude toward credit. Ideally, this means that all persons who had scale scores of three agreed to the same three statements; those who had scale scores of four agreed to the same three plus an additional statement; those with scale scores of five agreed to the same four as those with a score of four plus an additional statement, and so on.

^{3/} There were about 250 farmers in the farm sample.

Scaling Procedure

If the number of statements is relatively small and there are only a few respondents, the scaling may be done manually. If the number of respondents is large, scaling is done more readily by using a sorter and a reproducing punch machine after the responses to the statements have been punched on cards. In this study, the machine method was used.

A method of scaling statements by machine was developed by Carol L. Stone,^{4/} using Robert H. Ford's procedure of weighting the statements. With this method, the weights are increased in a modified geometric progression. Each respondent is given a geometric score that may be attained in only one way. In a seven-statement scale, a respondent with a negative response to each of the seven questions would have a geometric score of 0. This is the only way in which this score can be attained. Similarly, if a respondent gave a positive answer to each of the seven statements, he would have a geometric score of 127, or $(2^7 - 1)$. Between 0 and 127 are 126 possible geometric scores. Of these, the scores 0, 1, 3, 7, 15, 31, 63, and 127 will contain no errors, while all others will contain errors. An error exists when there is a negative response to a statement for which a positive response is expected, and vice versa. The geometric score is obtained by adding the weights of the statements answered positively.

For example, statement 1, the statement most frequently answered positively, has a weight of 1; statement 2, the next most frequently answered positively, has a weight of 2; statement 3 has a weight of 4. Taken together, these three give a geometric score of 7. The errors are recorded and distributed as explained later. Table 1 illustrates some response patterns. For example, respondent I has a geometric score of 95. He obtained this score by answering positively all statements except the sixth. Had he answered that statement positively, he would have had a perfect score of 127. His score was obtained by adding the weights $(1 + 2 + 4 + 8 + 16 + 64)$ or 2^n for all positive responses.

Table 1. - Response pattern by question and respondent

Respondent	Response to question							Geometric score	Scale score	Number of errors
	1	2	3	4	5	6	7			
A	-	-	-	-	-	-	-	0	0	0
B	-	+	-	-	-	-	-	2	2	1
C	+	+	+	-	-	-	-	7	3	0
D	+	+	+	-	-	-	+	71	3	1
E	+	+	-	+	-	+	-	43	4	2
F	+	+	+	+	-	-	-	15	4	0
G	+	+	+	+	+	-	-	31	5	0
H	+	+	+	+	+	+	-	63	6	0
I	+	+	+	+	+	-	+	95	7	1
J	+	+	+	+	+	+	+	127	7	0
Weights	1	2	4	8	16	32	64			

^{4/} Stone, C. L. A Machine Method for Scaling as Many as Twelve Dichotomies. Wash. Agr. Expt. Sta. Cir. 329, 15 pp., illus. 1958.

The geometric score shows the actual response and error pattern of the respondents, but for most purposes, the scale score is more important. The scale score corresponds to the response category of the respondent. In the case of respondent I (table 1), the scale is 7, as though he had answered all seven statements positively but with one negative error. The reason for this classification is that he most resembles the group with a scale of 7. Respondent B is given a scale score of 2 with one negative error. (He might also have been put in the group with a scale score of 0 with one positive error.) In both examples, the error given the respondent is evident. In other instances, the errors may not be so evident, and there may be doubt as to the group to which he belongs. For example, respondent E has two errors, and his scale score is 4. In this instance, his error will need to be distributed among four statements so that it will not overweight the error pattern for any one statement. The errors are divided between each of the statements involved. Statement 3 will receive a two-thirds negative error, statement 4 a two-thirds positive error, statement 5 a one-third negative error, and statement 6 a one-third positive error. The total error is 2, of which one is positive and one negative.

Guttman set down three criteria, which allow us to determine whether or not the completed scale is effective:

- (1) The coefficient of reproducibility must be 0.90 or over. The coefficient is calculated by totaling the number of errors and dividing this sum by the number of respondents times the number of items, all subtracted from 1 or:

$$\text{coefficient of reproducibility} = 1 - \frac{\text{total number of errors}}{\text{number of respondents} \times \text{number of items}}$$

It has a possible range from zero to one.

- (2) No item (statement) on the scale may have total positive or negative errors that add to more than 50 percent of the positive responses (for positive errors) or negative responses (for negative errors).
- (3) The total number of errors for any item may be no more than 15 percent of the total number of responses for that item.

A table such as table 2 is used to determine whether these criteria are met. The table shows for each statement the number of positive responses and their associated errors, the number of negative responses and their associated errors, total errors, and the percentage of error for each item (or schedule statement).

The figures in table 2 were obtained by counting the number of positive and negative responses and errors. This may be done from a listing sheet if the machine method of scaling is used. With this table, each statement can be checked with respect to the three criteria listed.

Critique

Certain problems emerge in using the Guttman scale for analysis of attitudes. A sample of at least 100 respondents is needed for any scale to be constructed. If users of credit are to be compared with those not using credit by scale types and other factors, a sample of 100 of each is needed. Constructing a set of statements

Table 2. - Guttman scale analysis for credit attitudes 1/

Schedule statement	Positive		Negative		Total errors	Percentage of errors
	Responses	Errors	Responses	Errors		
	Number	Number	Number	Number	Number	Percent
1-----	192	0	19	13.01	13.01	6.16
2-----	178	3.99	33	18.51	22.50	10.66
3-----	178	4.49	33	13.83	18.32	8.68
4-----	145	7.17	66	20.66	27.83	13.18
5-----	130	12.84	81	9.16	22.00	10.42
6-----	85	16.34	126	4.83	21.17	10.03
7-----	33	10.70	178	0	10.70	4.81
Total -----					135.53	

$$\text{Coefficient of reproducibility} = 1 - \frac{135}{211 \times 7} = 1 - \frac{135}{1477} = 90.86\%$$

1/ Using the answers that 210 dryland farmers in Montana gave to 7 questions on use of short-term credit. The questions may be found in the appendix, page 21. Questions 5, 9, and 10 of the appendix list were eliminated from the analysis because of the number of positive or negative errors in the responses.

that will satisfy the requirements of a scale is not always easy. A pretest or two is needed to work the "bugs" out of the set, or there will be a chance of complete failure on the main trial. The scale calculations can be a long job if there are several hundred respondents, unless an accounting machine and a deck of cards for automatic machine scaling are available.

RANK CORRELATION

The second tool used in the credit study was rank correlation. This type of analysis can be useful when respondents are asked to judge the relative importance of a large number of objects or attributes and to rank them in serial order. This technique also allows the rankings of a number of respondents to be pooled into a serially ranked aggregation. The method permitted a determination of the borrower characteristics lenders believed to be important and the order of their importance. This part of the study included a sample of 71 lenders from the three types of lending agencies in Montana. These lenders were asked to rank in order of preference eight economic characteristics in one set and nine noneconomic characteristics in the second set.

Eight attributes from these two sets of characteristics were used in the analysis presented here. (See listing, page 12.) The aggregate rank of the eight items was then tested for statistical significance, using M.G. Kendall's coefficient of concordance.^{5/} This coefficient indicates the amount of agreement between the lenders; it can be used also to find the level of significance for the agreement. This method is relatively simple, which makes it an attractive tool for this type of economic research.

The method used in the study and the interpretations drawn from the resulting rank order are explained here. A measure of the agreement between lenders' rankings, the coefficient of concordance, is first discussed.

The coefficient of concordance is found by the formula:^{6/}

$$W = \frac{12S}{m^2(n^3 - n)} \quad \text{When: } W = \text{the coefficient of concordance} \quad (1)$$

S = the sum of the squares of the deviations from the mean.

m = the number of respondents

n = the number of objects being ranked.

W, as found by this formula, is a measure of the amount of agreement between the respondents; it varies from 0 to 1. If W = 0, there is complete disagreement, and if W = 1, there is complete agreement. To test the significance of W, we used a chi-square test, formula

$$X^2_F = m(n-1)W \quad \text{When } m, n, w, \text{ and } S \text{ are the same as in} \quad (2)$$

$$= \frac{S}{mn(n-1)} \quad \text{formula (1).}$$

The significance level for this chi-square is found with $v = n-1$ degrees of freedom. We reject the hypothesis that "there is no community of preference among respondents" if X^2_F is more than the value given for chi-square with degrees of freedom equal to $n-1$ at the 5-percent significance level.

As an example of the calculation of W and chi-square, the replies of lenders in ranking the economic attributes of borrowers were taken. To calculate W and chi-square, it was necessary first to list all individual rankings. In this example, there were eight columns, one for each attribute. Each column was then summed to find the sum of the individual rank order (table 3). After calculating the mean of these sums, the next step was to find the deviations from the mean for each column. The deviations were then squared and accumulated to give S. Then, using formula (1):

$$W = \frac{12(48837.975)}{(64)^2(8^3 - 8)} = \frac{586055.7}{(4096)(504)} = \frac{586055.7}{2064384} = .28389$$

Using this value of W, X^2_F was then calculated from formula (2).

$$X^2_F = 64(7) (.28389) = 127.182. \text{ Here, } m = 64; n = 8; \text{ and } W = .28389.$$

^{5/} Kendall, M.G. Rank Correlation Methods. Ed. 2, rev. and enl., New York, 1955, pp. 94-102.

^{6/} Kendall, page 96. See footnote 5.

Table 3. - Sum of individual rank orders and deviations from the mean of these sums

Sum of individual rank orders		Deviations from the mean	
ΣX_1	327	d_1	38.625
ΣX_2	158	d_2	130.375
ΣX_3	314	d_3	235.625
ΣX_4	358	d_4	69.625
ΣX_5	359	d_5	70.625
ΣX_6	195	d_6	93.375
ΣX_7	372	d_7	83.625
ΣX_8	224	d_8	64.375
Sum and mean $\Sigma X = 2307/8 = 288.375$			

A "Table of Significant Points" of $X_F^2/7$ showed that under $v = n - 1 = 7$ degrees of freedom, the calculated value of X_F^2 exceeds that reasonable level of significance, and the hypothesis that "there is no community of preference among the respondents" could be rejected. There was found to be agreement among the respondents, but the value of W showed that this agreement was not very high. The smaller the value of m , the higher the value that W must be before it reaches significant proportions. For example, in another question we found $m = 4$, $n = 7$, $w = .66964$, and $X_F^2 = 16.07136$ was not significant at the 0.02 level.

In the study reported, W was calculated for banks, the Farmers Home Administration, and production credit associations. Because of the size of the sample, no attempt was made to break it into lender types by area.

The rank order of the attributes resulting from this analysis may be found as a byproduct of S . The attribute with the lowest column total is ranked in first place; the next lowest total is the second-place attribute, and so on. The rank order of the attributes as judged by lenders was as follows:

- (1) Financial progress;
- (2) Loan history with agency;
- (3) Farming experience;
- (4) Scale of farm operation;
- (5) Buying habits, sales resistance;
- (6) Financial backing (informal);
- (7) Formal credit rating; and
- (8) Flexibility of farm business.

7/ Kendall, page 189, appendix table 8. See citation, footnote 5, page 11.

The rank correlation test is simple to conceive and execute. But it fails to distinguish with precision items that rank approximately at the same point on the continuum. A more serious disadvantage, however, is the difficulty of getting a respondent to rank a large number of items. Eight or ten items are about the limit that most respondents can rank without introducing errors of design. It is possible to break a long list into two shorter lists, then to combine the rankings statistically. This can be done only if the researcher designs the experiment with this end in view. This was not done in the study reported, and it ended up with two rankings that cannot be combined into one valid preference ordering.

PAIRED COMPARISONS

The third technique applied to the credit study was that of paired comparisons. Like the Guttman scale, this technique was borrowed from the motivational research people, and also like the Guttman scale, it is very useful in this type of economic research.

The technique of paired comparisons is an alternative way of doing the same thing described in the section on rank correlation. The two methods are equally easy to use, but the paired comparison technique allows the calculation of scale separations for the factors ranked. This shows how much more important, in terms of an ordinal measure, any one factor is than each other factor in the scale.

The theory behind this method rests on six assumptions:8/

- (1) For all responses of individuals making the judgments there will be a modal or most frequently appearing response;
- (2) These responses are normally distributed, in which case the mode, median, and mean are the same;
- (3) The series of factors may be ranked;
- (4) The resulting rank can be tested for statistical validity;
- (5) The factors are nonrandom; and
- (6) The errors are distributed approximately according to chi-square.

The first two of these assumptions are required to find the scale separations. The last four are necessary in testing the rank order of agreement among the respondents.

A coefficient of agreement can be computed that will indicate to what extent the respondents agree in their comparative judgments. The scale separations and the test of significance will indicate whether or not the items belong on the same continuum. The procedure is to select factors that the researcher believes should fall on the same continuum, then to pair each factor with every other factor, giving $n(n-1)/2$ pairs, in which n is the number of factors ranked.

8/ Edwards, A.L. Techniques of Attitude Scale Construction. New York, 1957, pp. 20-81.

If the factors to be ranked do not lie on the same continuum, the significance test and the test for internal consistency will enable the researcher to determine which factor or factors are out of place. In the credit study, for example, the nine factors indicated by lenders to be important were paired, and the borrowers were asked to rank them in the order they believed lenders would rank them. (See listing of pairs in appendix, page 21.) The nine items were managerial ability, credit history, farming experience, cost of family living, mechanical ability, age of borrower, size of operation, reputation in the community, and ambition. When the scale separations were calculated, it was found that four of the nine - credit history, mechanical ability, cost of family living, and reputation in the community - did not belong on the same continuum.

In analyzing paired comparisons, it is well to find the scale values before testing for agreement between the respondents. Duplicate work can thus be eliminated if some of the items in the scale do not belong on the same continuum. In illustrating the method, the coefficient of agreement is the starting point, even though it should be found for the final rank.

In the credit study, as previously mentioned, 8 of the 17 attributes lenders had previously ranked plus the attribute "age of borrower," were paired, and the borrowers were asked to choose from each pair the attribute they felt the lenders considered the more important. The sample included 210 dryland grain farmers. This sample size permitted breaking the analysis into subgroups and testing for differences by both type-of-farming area and credit use.

Scaling Procedure

In the analysis, a matrix was used to show the number of times any one attribute was chosen over each other attribute. This required that the attributes be listed along one side and across the top of the matrix as in table 4. If the respondent showed no preference or felt that both items of the pair were equally important, a "no response" was recorded. These "no responses" were dealt with by giving one-half of 1 credit to each of the cells concerned. The matrix then showed the number of times each factor was chosen over each other factor in the aggregate. For example, reading across table 4, ambition was chosen over age of borrower 161.5 times; size of operation was chosen over age of borrower 177.5 times, and so on. After summing the columns, a rank order may be established by rearranging the matrix (as in table 4). The factor with the smallest sum is the factor in first place and is placed on the bottom of the matrix.

Table 4.- F matrix: Judgments of 210 farmers of importance of borrower attributes

Attribute	Rank	Judgment of farmers					Total
		5	4	3	2	1	
Age of borrower -----	5	---	161.5	177.5	171.0	193.0	703.0
Ambition-----	4	48.5	---	112.5	123.0	167.0	451.0
Size of operation-----	3	32.5	97.5	---	123.0	150.5	403.5
Farming experience---	2	39.0	87.0	87.0	---	145.0	358.0
Managerial ability ----	1	17.0	43.0	59.5	65.0	---	184.5
Total -----		137.0	389.0	36.5	482.0	655.5	2,100.0

Testing for coefficient of agreement among the respondents was done by the formula: 9/

$$u = \frac{2\Sigma}{\binom{m}{2} \binom{n}{2}} - 1 \quad \text{in which } u = \text{coefficient of agreement,} \quad (3)$$

varying from a maximum of 1 (for perfect agreement) to a minimum of $-1/(m-1)$ if m is even, or $-1/m$ if m is odd,

m = number of respondents (210 in example),

n = number of items being ranked
(5 in example),

$$\binom{m}{2} = +0.5m(m-1) = {}_mC_2. \quad (\text{In example: } {}_mC_2 = {}_{210}C_2 = 21,945),$$

$$\binom{n}{2} = {}_nC_2. \quad (\text{In example: } {}_nC_2 = {}_5C_2 = 10),$$

in which the summation (Σ) occurs for values below the diagonal:

$$\Sigma = \Sigma (\gamma)^2 - m \Sigma (\gamma) + \binom{m}{2} \binom{n}{2} \quad \text{in which } \gamma \text{ is the value of each cell in the matrix.} \quad (4)$$

This provides a means of determining the extent to which the group of respondents agreed in their comparative judgments.

The significance test for the coefficient of agreement indicated whether or not the level of agreement calculated could be attained if the comparative judgments of the respondents were random. The formula for the chi-square test is:

$$X^2 = \frac{4}{m-2} \cdot \left[\Sigma - 0.5 \binom{m}{2} \binom{n}{2} \cdot \frac{(m-3)}{(m-2)} \right] \quad (5)$$

in which Σ = value obtained by formula 4.

The degrees of freedom (v) for chi-square are given by the formula:

$$v = \binom{n}{2} \frac{m(m-1)}{(m-2)^2} \quad (6)$$

In the credit study, it was found that

$$u = \frac{2\Sigma}{\binom{m}{2} \binom{n}{2}} - 1 = \frac{2(137,967)}{219,450} - 1 = 0.257.$$

Testing this for significance by chi-square,

$$X^2 = \frac{4}{210-2} \left[137,967 - 0.5(219,450) \frac{207}{208} \right] = 54.74$$

and the degrees of freedom for chi-square were

$$v = 10 \left[\frac{43,890}{43,264} \right] = 10.14$$

9/ Edwards, pages 19 to 81. See citation, footnote 8, page 13.

A chi-square table was then checked to determine whether or not this value of u was significant. $X^2 = 54.74$ was found to be significant, therefore the value of u was significant. Also, the level of agreement was not high.

To find scale values and test for internal consistency in the judgments, the proportion of times each item was chosen over each other item was calculated from table 4 for each cell. For example, in the cell (age of borrower, ambition), the proportion was $.769 = 161.5/210$. In the cell (age of borrower, size of operation), the proportion was $.945 = 177.5/210$. In those cells in which the item was compared with itself, a proportion of .500 was inserted. Table 5 gives these proportions as computed from data in table 4.

The next step was to calculate the Z_{ij} values, sum of the cells, for each P value. The Z_{ij} values were found by using a "Table of Normal Deviates Z, Corresponding to Proportions P, of a Dichotomized Unit Normal Distribution." This table shows the Z value corresponding to each P value. It gives a positive value for P for values greater than .500, and a negative value for those less than .500. The Z_{ij} values for table 5 are found in table 6.

From this Z matrix was found the mean of the Z_{ij} values for each column. Then from the Mean Z_{ij} values were obtained the scale values by setting the item with the lowest rank at .000 (item 5, age of borrower), then adding the differences between each of the other values. For example, $\text{Mean } Z_1 - \text{Mean } Z_2 = .729$ is the scale value for ambition and $.729 + \text{Mean } Z_2 - \text{Mean } Z_3 = .871$ is the scale value for size of operation.

Table 5.— P matrix corresponding to F matrix

Attribute	Rank	P values for attribute				
		5	4	3	2	1
Age of borrower -----	5	.500	.769	.945	.814	.919
Ambition-----	4	.231	.500	.536	.586	.795
Size of operation-----	3	.155	.464	.500	.586	.717
Farming experience-----	2	.186	.414	.414	.500	.690
Managerial ability -----	1	.081	.205	.283	.310	.500

Table 6.— Z matrix corresponding to P matrix

Attribute	Rank	Z values for attribute				
		5	4	3	2	1
Age of borrower -----	5	.000	.736	1.015	.893	1.398
Ambition-----	4	-.736	.000	.090	.217	.824
Size of operation-----	3	-1.015	-.090	.000	.217	.574
Farming experience-----	2	-.893	-.217	-.217	.000	.496
Managerial ability -----	1	-1.398	-.824	-.574	-.496	.000
Sum of Z_{ij} -----		-4.042	-.395	.314	.831	3.292
Mean Z_{ij} -----		-.808	-.079	.063	.166	.658
Rank of j -----		.000	.729	.871	.974	1.466

The scale values for all five attributes were thus obtained. The next step was to test the rank order and scale separations for internal consistency. This was done by comparing the theoretical proportions with the observed proportions. It involved finding the theoretical normal deviates Z_{ij} corresponding to the scale differences between the items. The normal deviate for each item was calculated from its scale value. Table 7 contains the theoretical normal deviates for the five attributes. These are the differences between the scale values derived in table 6. Column 5 is the scale value and each of the other columns are differences from the preceding column.

The theoretical proportions for the attributes were found from a Table of Normal Deviates by reversing the order in obtaining the values for the Z matrix (table 6). For example, the -.727 in the cell (4-5) in table 7 was looked up in the Table of Normal Deviates and the proportion corresponding to it (.233) was found in the margin of the table. These theoretical proportions are shown in table 8.

After the theoretical proportions were found, they were converted into angles in terms of degrees (θ), from a "Table of Angular Transformation of Percentages to Degrees." This yielded the values for θ and θ' , which were compared and the discrepancies between them squared and summed. Table 9 shows these values for this example.

The internal consistency test, which came next, was accomplished by using the chi-square formula:

$$\text{Chi-square} = X^2 = \frac{(\theta - \theta')^2}{821/m} \quad (7)$$

in which: θ = observed angles in degrees,
 θ' = expected angles in degrees, and
 m = number of respondents (210)

In the example, $\Sigma(\theta - \theta')^2 = 23.75$

$$\text{and } X^2 = \frac{23.75}{821/210} = 6.06$$

$$\text{Degrees of freedom} = v = \frac{(n-1)(n-2)}{2}.$$

in which n = number of factors ranked.

$$\text{In the example, } v = \frac{(5-1)(5-2)}{2} = 6.$$

The null hypothesis tested with this chi-square was: "the assumptions that have been made about this model are tenable." These are the assumptions listed on page 13. The null hypothesis is rejected if the calculated chi-square is greater than the tabulated chi-square at the .05 significance level for the applicable degrees of freedom. In this example, the calculated value of chi-square was 6.06 and the tabulated value was 12.59 at the .05 significance level with six degrees of freedom. Therefore,

Table 7.- Theoretical normal deviates Z_{ij} corresponding to scale differences between items in the Z matrix

Attribute	Rank	Theoretical Z values for attribute				
		5	4	3	2	1
Age of borrower -----	5	.000				
Ambition-----	4	-.729	.000			
Size of operation-----	3	-.871	-.142	.000		
Farming experience--	2	-.974	-.245	-.103	.000	
Managerial ability ---	1	-1.466	-.732	-.595	-.492	.000

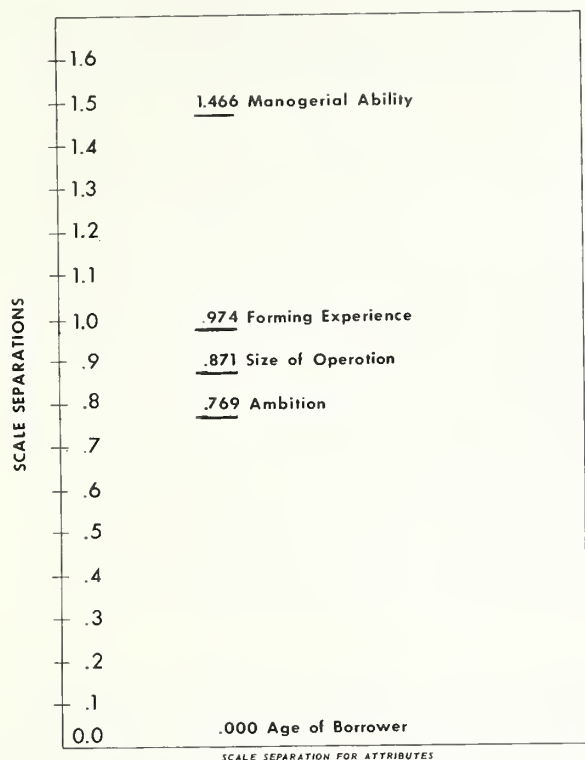
Table 8.- Theoretical proportions for alternatives corresponding to the P matrix

Attribute	Rank	Theoretical P values for attribute				
		5	4	3	2	1
Age of borrower -----	5	.000				
Ambition-----	4	-.233	.000			
Size of operation-----	3	-.192	-.444	.000		
Farming experience--	2	-.165	-.402	-.459	.000	
Managerial ability ---	1	-.071	-.231	-.276	-.311	.000

Table 9.- Values of θ and θ' observed and expected proportions converted into angles in terms of degrees

Item	Rank	Attribute -				
		5	4	3	2	1
		<u>Degrees</u>	<u>Degrees</u>	<u>Degrees</u>	<u>Degrees</u>	<u>Degrees</u>
θ value of -						
Ambition-----	4	28.73				
Size of operation---	3	23.19	42.94			
Farming experience :	2	25.55	40.04	40.04		
Managerial ability -	1	16.54	26.92	32.14	33.83	0
θ' value of -						
Ambition-----	4	28.86				
Size of operation---	3	25.99	41.73			
Farming experience :	2	23.97	39.35	42.65		
Managerial ability -	1	15.45	28.73	31.69	33.89	0

the null hypothesis could be accepted, and the assumptions said to be tenable. The rank order and scale separations are shown in figure 1.



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If the null hypothesis is rejected, two alternatives are open: (1) The items can be rescaled under the assumptions of case III or (2) the discriminial dispersions can be calculated for the items in the present model. If the discriminial dispersions are calculated, it is possible to determine any items that do not belong on the continuum. If one is found, it may be eliminated from the matrix and the remaining items may then be rescaled under the assumptions on case V.^{10/}

Critique

The paired-comparison technique allows a precise measure of an attitudinal continuum not possible with a rank correlation. The number of pairs involved becomes awkward if a long list of items must be ranked. In the example above, nine items resulted in a list of 36 pairs. Farmers were willing to work with this many pairs, but how much longer the list could have been without a negative reaction is not known. The responses were broken down into subgroups by various identification factors, and the resulting scales were tested in contingency tables or by another method. In this way, it was possible to arrive at statistically valid inferences for the responses and to establish hypotheses of causation relating attitudes to such things as size of farm, geographic area, educational level, previous experience, and so on. They are not quite as good as predictive explanations, but they are at least the basis for a series of informed guesses. These data were better than those usually dealt with in management analyses.

^{10/} Edwards, pages 58-66. See citation, footnote 8, page 13. For this method, Thurstone lists 5 cases. The assumptions for case III are somewhat more rigid than those for case V and for most purposes, we need not go to case III in the tests as once the discriminial dispersions are calculated, the items may be rescaled under case V after the item which caused the discrepancies has been eliminated.

COMPARATIVE UTILITY OF THE THREE TECHNIQUES

The question usually asked when a study such as this is completed is "What does all this tell us?" From table 2 (the Guttman scale), we can see that farmers have a positive attitude toward the use of credit. In addition, we can see that even though farmers may prefer other methods of financing their operations, they do not dislike using short-term credit.

The rank order of borrower attributes from both lenders and borrowers was obtained to determine whether lenders communicate adequately the importance of certain attributes to the borrower. If the lenders were so communicating, the ranks should be similar. The results of the study showed that bankers communicate fairly well. The listing below and figure 1, page 19, compare the 17 attributes ranked by lenders and the 5 ranked by borrowers. Lenders and borrowers disagreed on only 2 attributes; (1) ambition, and (2) size of operation. All three groups of lenders ranked ambition near the top. At the same time, only the FHA's ranked size of operation above 13th in importance. Borrowers, on the other hand, reversed these two attributes, ranking size of operation slightly above ambition. This indicates that in talking with borrowers, lenders tend to overemphasize size of operation and to underemphasize ambition, thus giving borrowers the impression that size of operation is the more important. The scale separations of the borrower rankings indicate that borrowers consider managerial ability far more important than the other four attributes.

When the two rankings are compared, the paired-comparisons method is seen to be the more precise. On the borrowers' side, a rather close grouping of characteristics in the middle of the scale is found, while on the lenders' side, it is not known whether or not a grouping exists. This can be important as there have been situations in which one item ranked above another but only by a very slight amount, indicating that actually the two may be equally important.

Importance of borrower characteristics as ranked by three types of lenders in the northeastern spring wheat area of Montana, are shown below:

<u>Bankers</u>	<u>PCA's</u>	<u>FHA's</u>
1. Financial Progress	Financial Progress	Management Practices
2. Ambition	Management Practices	Farming Experience
3. Loan History	Ambition	Ambition
4. Management Practices	Cooperativeness	Financial Progress
5. Cooperativeness	Loan History	Scale of Operation
6. Buying Habits	Farming Experience	Cooperativeness
7. Farming Experience	Cooperativeness of Family	Loan History
8. Formal Credit Rating	Level of Family Living	Flexibility
9. Cooperativeness of Family	Flexibility	Cooperativeness of Family

<u>Bankers</u>	<u>PCA's</u>	<u>FHA's</u>
10. Mechanical Skills	Buying Habits	Family and Marital Status
11. Level of Family Living	Status in Community	Level of Family Living
12. Flexibility	Financial Backing	Buying Habits
13. Scale of Operation	Family and Marital Status	Status in Community
14. Financial Backing	Scale of Operation	Formal Credit Rating
15. Family Background	Formal Credit Rating	Mechanical Skills
16. Family and Marital Status	Mechanical Skills	Family Background
17. Status in Community	Family Background	Financial Backing

APPENDIX

Questions Asked 210 Dryland Farmers

Part I

Farmers were asked the following questions to learn their general attitude toward use of short-term credit in their farming operations.

"In answering the questions please think of the 'normal' situation and not the boom or bust years. Answer these questions yes or no, whichever more nearly describes your opinion.

1. Do you think it is too easy to borrow more in normal years than you can pay back? Yes ____ No ____
2. Should farmers in general use short-term credit only when absolutely necessary? Yes ____ No ____
3. Do you believe that farmers who use short-term credit are poor managers? Yes ____ No ____
4. Do you think that short-term credit should be used as a part of the operating funds in the farm business? Yes ____ No ____
5. Does short-term credit release cash that can be spent on other things? Yes ____ No ____
6. Does borrowing put you at the mercy of the lender? Yes ____ No ____
7. Is short-term credit too expensive to use? Yes ____ No ____
8. Can short-term credit be used to increase your farm income? Yes ____ No ____
9. Can you afford to use more short-term credit? Yes ____ No ____
10. Once out of debt do you intend to stay out? Yes ____ No ____ "

Part II

The 210 dryland farmers were also asked to select from each pair the attribute they believed lenders held to be the more important when considering whether or not to grant a short-term loan. The question asked farmers was as follows:

"When deciding to make a loan, lenders consider the ability of the farm to repay and the security it can offer. We think that the items used to make up these comparisons are additional factors the lender considered. Credit users: Indicate which one you think is more important to the man you arrange your credit with in dealing with you. Noncredit users: Indicate which one you think would be most important to a lender in extending credit to you.

- | | |
|---|--|
| 1. A. <input type="checkbox"/> Reputation in the community
B. <input type="checkbox"/> Ambition | 14. A. <input type="checkbox"/> Ambition
B. <input type="checkbox"/> Cost of family living |
| 2. A. <input type="checkbox"/> Management
B. <input type="checkbox"/> Mechanical ability | 15. A. <input type="checkbox"/> Size of operation
B. <input type="checkbox"/> Reputation in the community |
| 3. A. <input type="checkbox"/> Size of farm operation
B. <input type="checkbox"/> Farming experience | 16. A. <input type="checkbox"/> Cost of family living
B. <input type="checkbox"/> Credit history |
| 4. A. <input type="checkbox"/> Ambition
B. <input type="checkbox"/> Mechanical ability | 17. A. <input type="checkbox"/> Mechanical ability
B. <input type="checkbox"/> Size of operation |
| 5. A. <input type="checkbox"/> Age of borrower
B. <input type="checkbox"/> Cost of family living | 18. A. <input type="checkbox"/> Cost of family living
B. <input type="checkbox"/> Management |
| 6. A. <input type="checkbox"/> Credit history
B. <input type="checkbox"/> Mechanical ability | 19. A. <input type="checkbox"/> Age of borrower
B. <input type="checkbox"/> Farming experience |
| 7. A. <input type="checkbox"/> Age of borrower
B. <input type="checkbox"/> Ambition | 20. A. <input type="checkbox"/> Management
B. <input type="checkbox"/> Age of borrower |
| 8. A. <input type="checkbox"/> Management
B. <input type="checkbox"/> Reputation in the community | 21. A. <input type="checkbox"/> Reputation in the community
B. <input type="checkbox"/> Cost of family living |
| 9. A. <input type="checkbox"/> Credit history
B. <input type="checkbox"/> Farming experience | 22. A. <input type="checkbox"/> Ambition
B. <input type="checkbox"/> Size of operation |
| 10. A. <input type="checkbox"/> Size of operation
B. <input type="checkbox"/> Age of borrower | 23. A. <input type="checkbox"/> Management
B. <input type="checkbox"/> Credit history |
| 11. A. <input type="checkbox"/> Management
B. <input type="checkbox"/> Ambition | 24. A. <input type="checkbox"/> Farming experience
B. <input type="checkbox"/> Mechanical ability |
| 12. A. <input type="checkbox"/> Reputation in the community
B. <input type="checkbox"/> Farming experience | 25. A. <input type="checkbox"/> Reputation in the community
B. <input type="checkbox"/> Credit history |
| 13. A. <input type="checkbox"/> Age of borrower
B. <input type="checkbox"/> Credit history | 26. A. <input type="checkbox"/> Farming experience
B. <input type="checkbox"/> Cost of family living |

27. A. ☐ Age of borrower
B. ☐ Reputation in the community
28. A. ☐ Size of operation
B. ☐ Cost of family living
29. A. ☐ Credit history
B. ☐ Ambition
30. A. ☐ Size of operation
B. ☐ Credit history
31. A. ☐ Farming experience
B. ☐ Management
32. A. ☐ Cost of family living
B. ☐ Mechanical ability
33. A. ☐ Management
B. ☐ Size of operation
34. A. ☐ Ambition
B. ☐ Farming experience
35. A. ☐ Age of borrower
B. ☐ Mechanical ability
36. A. ☐ Reputation in the community
B. ☐ Mechanical ability"

